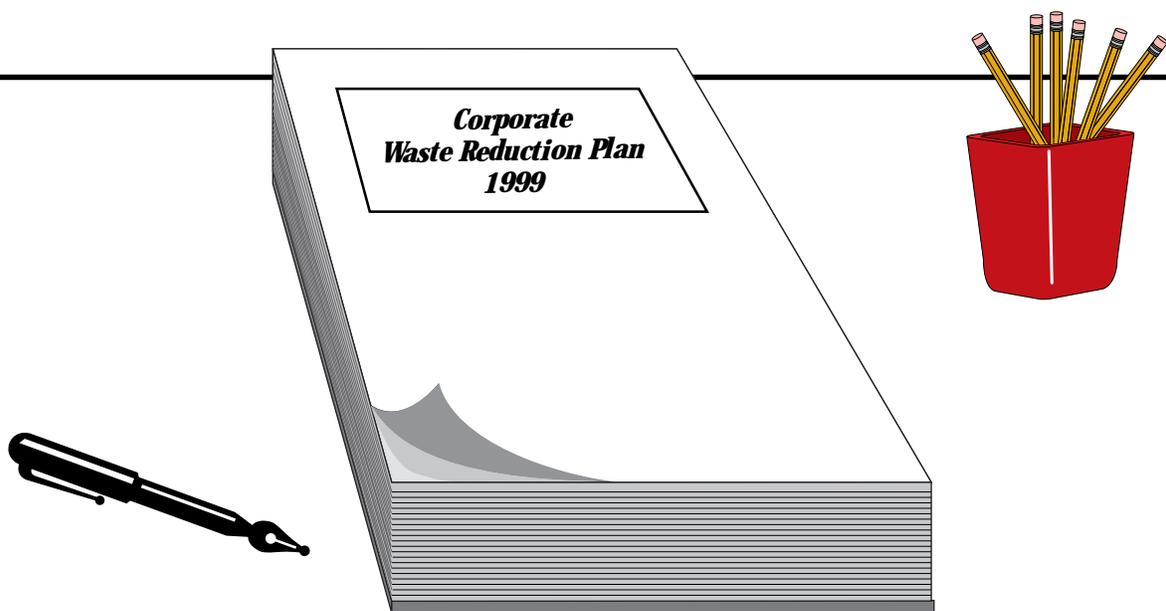


Writing a Waste Reduction Plan



1999

Prepared by:



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About This Handbook

This handbook will help you prepare a waste reduction plan for your business. By providing you with practical information on how to approach, plan and implement a hazardous waste reduction program, these pages should help you make the administrative, material and technology changes that result in less waste.

As you proceed through each section, you'll learn the steps for reviewing operations, identifying and assessing waste reduction options and implementing and measuring your progress. You should find answers to such questions as:

- How do waste reduction practices enhance regulatory compliance?
- Does Tennessee's law include EPA's requirements for a waste minimization "program-in-place?"
- How do I conduct a waste reduction assessment?
- What steps are involved in implementing various waste reduction practices?
- What specific waste reduction practices are businesses successfully using?
- Where can I go with my questions on waste reduction?

Because individual industries' needs vary widely, we encourage you to modify the procedures discussed here to meet your own unique requirements. This book serves as a point of reference, rather than a set of rigid requirements.

Introduction

In response to a growing concern that solid and hazardous waste problems needed more attention, the 1988 Tennessee General Assembly established a state waste reduction policy:

“Wherever feasible, the generation of hazardous waste is reduced or eliminated as expeditiously as possible. Waste that is generated should, in order of priority, be reduced at its source, recovered and reused, recycled, treated or disposed of so as to minimize the present and future threat to human health and the environment.”

The Tennessee Hazardous Waste Reduction Act of 1990 (TCA 68-212-301 et. seq.) requires that large and small quantity generators of hazardous waste develop a facility waste reduction plan. The law encourages in-plant changes to reduce, avoid or eliminate hazardous wastes.

The elements of a written facility plan (required by the Tennessee Hazardous Waste Reduction Act of 1990) are based on federal guidelines. Tennessee’s program is based on EPA’s voluntary “program-in-place.” The “program-in-place” meets certification requirements found on the Hazardous Waste Manifest.

Large quantity generators of hazardous wastes (generating more than 1000 kg in any calendar month) during the 1989 calendar year were required to develop a plan by January 1, 1992. Small-quantity generators (generating more than 100 kg and less than 1000 kg in any calendar month) had until January 1, 1994, to develop their plan. Hazardous waste streams created after 1989 do not require a waste reduction plan until at least three years after generation begins. Failure to comply with the Act may result in fines of up to \$10,000 per day.

Although Tennessee’s waste reduction policy is based on environmental concerns, waste reduction also has positive incentives for industry. Waste in whatever form represents lost resources, lost money and sometimes even lost labor. Therefore, reducing waste makes sense in today’s competitive marketplace. A well-designed waste reduction plan reduces operating costs, liability risks and waste handling and disposal costs. It can also significantly enhance a company’s public image and strengthen its reputation as a responsible member of the community.

What Is Waste Reduction?

In its broadest sense, waste reduction includes all practices that reduce the amount of unwanted materials entering the environment, whether hazardous or not. For regulatory purposes, however, the term applies only to releases of hazardous substances, pollutants or contaminants. The Tennessee Hazardous Waste Reduction Act of 1990 does not apply to the reduction of hazardous air emissions or wastewater discharges.

Methods for achieving waste reduction divide conveniently into two basic types: source reduction and recycling.

Source reduction is any action that reduces the amount of waste exiting a process. Source reduction measures include:

- Modifications to equipment or technologies.
- Modifications to processes or procedures.
- Reformulation or redesign of products.
- Substitution of raw materials.
- Improvements in housekeeping, maintenance, training or inventory control.

Recycling is the use, reuse or reclamation of a waste, either on or off site, after it is generated. Recycling methods include:

- Using or reusing a waste as a substitute for a commercial product.
- Reusing a waste in order to delay the purchase of new commercial product.
- Removing contaminants from a waste to allow its reuse.
- Reclaiming useful constituents from within a waste material.

What Goes Into the Plan?

In general, the law says your plan must contain:

- A written policy of management and corporate support for planning efforts and a commitment to implementation.
- Written scope and objectives of the plan and establishment of quantitative, production-related performance goals. (You can include a description of any hazardous waste reduction accomplished prior to the planning law.)
- Options to be evaluated and a schedule for implementation based on a waste reduction assessment. Details of the plan should include:
 - ✓ A list of all hazardous waste streams.
 - ✓ An assessment of whether you need to set performance goals. If goal-setting isn't practical at this point, list actions which will lead to establishing them in the future.
 - ✓ An evaluation of the processes, operations and activities that involve toxic substances and create hazardous waste.
 - ✓ An evaluation of reduction options for each waste that you target in your plan's performance goals.
- A system for tracking and managing waste costs. This is not a separate accounting system, but a tool for better understanding the true costs of generating, handling and disposing of your hazardous wastes.
- Employee awareness, involvement and training programs for waste reduction efforts.
- A description of your procedures to make waste reduction an ongoing effort.
- An annual update of your waste reduction efforts, hurdles and accomplishments.

Pages 6–28 take you through a nine-step process for writing and implementing a waste reduction plan. Included with each step is an exercise with this symbol:



DO IT NOW!

Each “Do It Now!” exercise will help get your plan into writing. Instructions for updating your plan are presented on page 31, while guidelines for using your plan to complete the Annual Report of Hazardous Waste Activity are discussed on page 32.

Steps to Writing a Waste Reduction Plan

Step 1. Get Management Commitment

Since management establishes the goals and policies for your organization, a successful waste reduction program requires sincere management commitment. The program must become a functioning part of a firm's standard operating procedures, including product development, operational procedures and training. High-level management commitment keeps the waste reduction program active in all areas of the company by committing time, personnel and money. Lack of commitment often becomes an obstacle to waste reduction.

A formal policy statement best conveys waste reduction program objectives to employees. Consider including these points in your environmental policy statement or operating guidelines:

- Make the production line responsible for environmental protection. Measure employee performance against the set goal. In addition, make every employee as responsible for environmental protection as he or she is for safety and quality.
- Reducing or eliminating waste is a main goal in research, process design and plant operations. It is as important to management as safety, yield and loss prevention.
- Consider reusing materials before classifying and disposing them as hazardous waste.

In the policy statement for your facility, you may also want to list motivations for waste reduction planning, such as regulatory requirements, product quality, cost and liability control and worker health and safety. Make the language appropriate to your facility.

You should consider developing a broad, flexible environmental policy. Do you only want to seek compliance, or do you want to do more? How environmentally friendly do you want your organization to be? Do you want to be seen as a leader in environmental issues, or do you prefer a more conservative approach? Remember: it is more important to actually follow your environmental policy, simple though it may be, than to have an eloquent policy that you ignore.

NOTE: The policy statement required in ISO 14001, the international standard for environmental management systems, is much more comprehensive than the one required for this plan. Still, your waste reduction policy statement may be a good starting point if you ever decide to pursue ISO 14001 certification.

Sample Waste Reduction Policy Statements

- I. [Company Name] advocates a clean and safe environment. Its policy is to minimize the generation of hazardous and nonhazardous solid wastes and, insofar as possible, to eliminate air and water pollutants. It seeks the help of all employees in achieving these objectives. Further, [Company] wants its employees to be fully aware of all hazardous and potentially dangerous chemicals or equipment used in the work place and to use them in a completely safe manner. Finally, it is [Company]'s desire to operate in full compliance with all applicable environmental regulations.
- II. [Company Name] is committed to excellence and leadership in protecting the environment. In keeping with this policy, our objective is to reduce waste. We strive to minimize adverse impact on the air, water and land through excellence in waste reduction. By successfully reducing waste at its source, we can achieve cost savings, increase operational efficiencies, improve the quality of our products and services and maintain a safe and healthy workplace for our employees. Also, [Company Name] promotes environmentally sound recycling, reuse and reclamation of all waste streams.
- III. At [Company Name], protecting the environment is a high priority. We are pledged to eliminate or reduce, wherever possible: 1. our use of toxic substances; 2. our release of toxic pollutants; and 3. our generation of hazardous and other wastes. When wastes or releases cannot be avoided, we are committed to recycling, treating and disposing these materials in ways that minimize undesirable impacts on the air, water and land.
- IV. [Company Name]'s policy is to reduce all hazardous and nonhazardous waste to the minimum levels economically and technically practical and to be in full compliance with all federal and state waste regulations.
- V. As both a responsible citizen and [Company Name] employee, each individual is responsible for reducing waste during working hours, for complying fully with all waste reduction program goals established by the company, and for not violating any federal or state waste regulations. Employees are urged to come forth with suggestions for further reducing waste in their own work area and in any other areas about which they may have ideas.

Once management signs and dates the policy statement, display it prominently and distribute it widely. How you first distribute the written policy to employees indicates company commitment. Posting it unexpectedly at workstations sends a negative message. Calling a special meeting to review Tennessee's hazardous waste reduction program, explaining and distributing copies of your company's own policy, and asking for employee ideas and input all send a positive signal and improve your chances for success.

Although a commitment to reducing waste should begin with management, employees often suggest valuable improvements in day-to-day operations. Therefore, you should inform and involve employees at each step in developing and implementing a program. Employee involvement will be discussed later in this manual.



DO IT NOW! *Draft a realistic waste reduction policy for your facility.*

Now, evaluate the policy:

- Is it clear and concise?
- Is it measurable, memorable and motivational?
- Is it achievable, yet challenging?
- Would you be willing to sign it and have it posted in the plant with your picture?
- Would you feel proud sharing your policy with the general public?

If you answered **yes** to all these questions, you have a great policy! If not, rewrite the policy to include any improvements.

Step 2. Define Scope, Objectives and Goals

The scope of the hazardous waste reduction plan may be to do any or all of the following:

- Include all managers and employees in implementing the company's policy.
- Include all wastes in your reduction efforts.
- Use every available resource to reduce or eliminate the hazardous waste you generate.

For this law, only hazardous wastes are required to be considered, but it is a good business practice to consider all wastes.



DO IT NOW! *State the scope of your waste reduction plan.*
(What wastes do you want to reduce?)

Did you include any of the following waste types? While not mandatory for compliance with this law, can you afford *not* to reduce these?

- Nonhazardous solid wastes.
- Universal wastes.
- Special wastes.
- Wastewaters.
- Air emissions.
- Energy wastes.

Writing a Waste Reduction Plan

What are the objectives of your plan? Compliance with the law, of course, but do you want more from this effort? Saving money, reducing regulatory requirements and avoiding long-term liabilities are typical answers. Consider:

- Increasing employee participation.
- Using every available resource to reduce or eliminate your hazardous waste.
- The regular evaluation of technologies.
- The most effective use of policies and procedures.
- Improving employee training on environmental issues.
- Improving the waste reduction measurement methods.
- Improving the health and safety environment of the workplace.
- Encouraging a source reduction philosophy.
- Helping to meet the organization's economic and quality requirements.



DO IT NOW! *State the objectives of your waste reduction plan.*
(What do you want to accomplish?)

Defining a Standard Unit of Production

The *goal* for each hazardous waste you generate must be expressed as an actual quantity, not a percentage. In other words, it is not sufficient to set a reduction goal of, say, 25 percent. For example, if your current generation rate is 10 kg every time you clean up your paint booth and you want to cut your waste by one-fourth, your reduction goal is 2.5 kg per paint cleanup. The law states that the goal must be set in terms of a **standard unit of production**.

You establish the standard unit of production as a unit of measure for the specific process that generated this waste. In other words, why is the waste being generated? What is the reason for the waste? In the example above, the waste was generated because you cleaned up the paint booth. The standard unit of production is in terms of the waste production, not the production of your finished product. Each hazardous waste will have its own standard unit of production.

Tips for setting a standard unit of production:

- Measurable (preferably currently measured).
- Applies to this waste stream.
- Something that involves the employees.
- Something easy.
- Something in writing!

Examples of Standard Units of Production

If the reason for (source of) the waste is:	the standard unit of production might be:
• parts washer in maintenance department	• number of work orders
• parts washer in maintenance department	• hours of operation of the unit
• dry cleaner operation	• lbs of clothes washed
• byproduct from process	• lbs of product from process
• laboratory tests	• number of tests conducted
• paint waste from coating your product	• square footage of product coated

Confidential

The standard unit of production is confidential, but you should write it down in your plan as a memory aid. To assist in the confidentiality of the unit, you are allowed to disguise the unit. For example, instead of saying every work order, your unit could be every 1.5 work orders, or 100 work orders, or 1000 divided by the year your company was started!

Step 3. Make a Team

The keys to reducing waste generation—commitment, involvement and teamwork—are basic to many workplace successes. Owners and managers can determine priorities and set the tone of the company's waste management efforts, but it takes everyone to make it happen. Once everyone understands how reduction of hazardous waste fits into company policies and practices, opportunities for participation are unlimited. Everyone in the facility is involved in some way in changing how it operates.

The team approach is best since it combines a wide range of experience, knowledge and perception of the issues. A technically competent person with sufficient authority to do the job should select and lead the team—and since you are the one reading this manual, you are probably that person! Your team should include representatives from:

- Management
- Environmental
- Vendors/Suppliers
- Engineering
- Quality
- Consultants
- Production
- Operators
- Purchasing/Accounting

The importance of Training

No waste reduction program is successful without the full cooperation of all employees. That's why the Tennessee law includes a requirement for employee involvement. The role of training is very important in this regard. Training the staff allows everyone to help set achievable goals and to better understand their role in the waste reduction program.

Your waste reduction plan should include a description of the following:

- Types of awareness activities and courses provided.
- Schedule of awareness activities and training courses offered.
- Methods of documenting the training.

You can also secure employee commitment to waste reduction by training them in waste reduction procedures, encouraging them to come forth with ideas, asking them to participate in the setting of waste reduction goals and procedures, and providing them with incentives to achieve those goals.

Although a commitment should begin with management, production operators and line employees can often suggest improvements in the operations. They possess firsthand knowledge and experience with production and operation processes. They can assist especially in assessing operational or procedural changes, or in equipment modifications affecting the way they work.

To reduce waste successfully, management must recognize the value of both the waste assessment and employee involvement. If managers initiate the assessment and encourage employees to develop and implement the program, they will almost certainly see improvements in the waste reduction program.



DO IT NOW! *Select a team to help you set your goals and implement your waste reduction plan.*

When planning for waste reduction, ask yourself these three questions:

- Who can help you understand your facility?
- Who can help you change how your facility operates?
- Who can help you maintain your waste reduction plan as old challenges are met and new opportunities arise?

Step 4. Conduct a Waste Assessment

The likelihood of finding cost-effective options for reducing hazardous wastes is directly related to understanding the relationships between your operations, the substances used and the wastes generated. Enlarge your understanding of these relationships by reviewing plant operations and conducting a hazardous waste reduction assessment.

Consider a reduction assessment in several stages:

- Preview your plant's operations, chemical usage, business practices and wastes generated.
- Walk through your facility to verify your findings and identify reasons for your wastes.
- Document your findings.

The size and type of your business will determine how much effort you put into an assessment. The owner of a very small business might conduct an assessment on his own in a few hours. Larger manufacturing or multiple-process firms benefit from a team assessment that may take several weeks. You'll need several people with diverse skills to evaluate complicated waste streams, analyze multiple kinds of equipment and contribute to economic analyses. This is where the team approach to waste reduction is crucial.

What Is the Purpose of the Assessment?

Waste reduction assessments identify and profile waste streams, determine how they are generated and calculate the amount of waste they generate. A waste reduction assessment helps you identify cost-effective approaches to reducing waste volume and concentrations. You can then better decide how to use resources for source reduction and recycling programs. A waste assessment alone will not reduce a business's waste, but it's a good start.

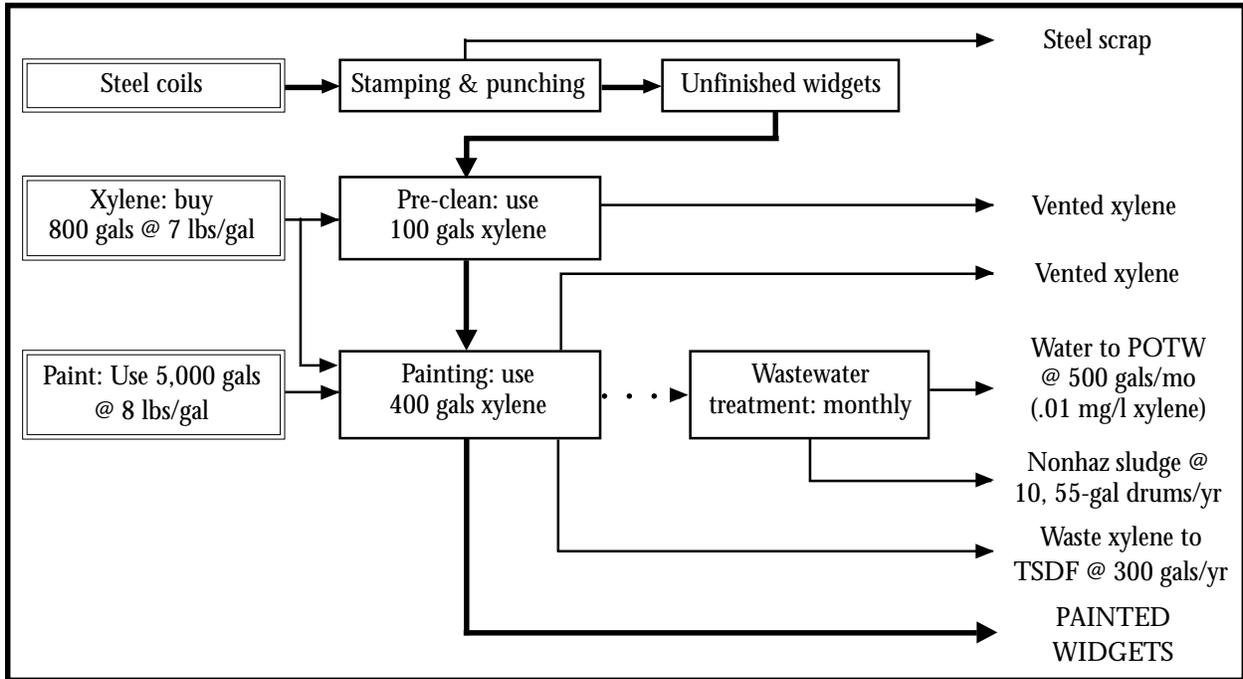
Waste reduction assessments are not onetime projects. Goals must be reevaluated as changes occur, whether in available technologies, raw material supplies, environmental regulations or economic climate. In fact, **Tennessee's waste reduction facility planning law requires an annual review and update of each facility's waste reduction plan and accomplishments.**

How Should We Prepare For the Assessment?

Your entire waste reduction team should be included in as much of the assessment as possible. You may need to provide some training beforehand, covering such topics as:

- What is a hazardous waste?
- Why is it hazardous?
- Which ones are in our facility?
- Why are we generating this waste?
- What is waste reduction?
- What are we looking for in this assessment?

Sample Waste Flow Diagram



DO IT NOW! *Create a waste flow diagram for each waste stream in your facility.*

What Should We Be Looking For?

Ask the following questions about your current operations:

- What are this facility's current processes/operations?
- Why do we conduct each process/operation the way we do?
- What are the consequences of doing each process/operation this way?
- What are the waste streams generated from each process, and how much is generated?
- Which wastes are classified as hazardous and which are not? What makes them hazardous?
- What input materials do we use that generate waste streams?
- How much input material from a particular process enters each waste stream?
- How much of a raw material can we account for through fugitive losses?
- How efficient is the process?
- Are unnecessary wastes generated by mixing otherwise recyclable hazardous wastes with other process wastes?
- What types of housekeeping practices do we use to limit wastes?
- What types of process controls do we use to improve process efficiency?

Before the assessment walk-through, have the waste reduction team answer these questions and prepare an agenda of points still needing clarification. The list can contain objectives, questions and further concerns.

Know Your Facility

After the assessment team identifies waste streams and creates a checklist, it's time to survey the plant site. Become as familiar with the site as possible. Although the information you collected is critical to understanding the processes involved, seeing the site in operation is also important. For example, a process unit may operate differently from the method originally described in the operating manual. Employees may have made undocumented changes in flow diagrams or to equipment. The site inspection resolves questions which might arise during your review.

The site inspection also provides information that supplements what you learned earlier. Throughout the tour, team members should use the inspection checklist, ask questions about the above items, verify information previously collected, and look for specific opportunities to reduce waste. They should also make a point of talking with the employees who oversee processes and operate equipment. Their collective experiences and insights concerning waste reduction can be most valuable.

As you proceed through your survey, or soon afterwards, review all your data. This review can help you identify missing or inaccurate information and allow you to make additions and corrections to the waste flow diagram. Examine each step in the manufacturing process from the delivery of the material to the storage and shipping of the final product.

Other Components of the Waste Assessment

- **Alternative procedures and process decisions.**
 - ✓ Identify housekeeping and operating procedures that will reduce wastes and include a description of these new operating procedures in the plan.
 - ✓ Survey production equipment and facility technologies to ensure no excessive waste is generated.
 - ✓ Review employee-training programs to include waste reduction goals and to encourage employee participation in the program.
- **Inventory of raw material supplies and waste sources.**
 - ✓ Material and waste balances.
 - ✓ Sources of chemical use and waste generation.
 - ✓ Points of waste discharge.
 - ✓ Chemical profile of wastes (why they are hazardous).
 - ✓ Waste disposal costs.
- **Priority framework.**
 - ✓ Review chemical hazards.
 - ✓ Assess risk.
 - ✓ Estimate cost of waste reduction (include initial costs, amortization, depreciation, tax rebates and payback potential).
 - ✓ Estimate liability costs, especially long-term.
 - ✓ Identify management criteria for importance.
 - ✓ Prioritize wastes for the reduction program.



DO IT NOW! *Conduct a waste assessment of your facility.*

- 1. *Fill out the Facility Waste Assessment form on page 20.***
- 2. *Begin filling out the Waste Reduction Options Worksheet on page 25. Identify two waste streams for your facility, then fill in line 1 (current generation) and line 2 (the standard unit of production).***

Facility Waste Assessment

(Copy this form and use one for each process, operation or activity)

DATE: _____ **FACILITY:** _____

PROCESS, OPERATION OR ACTIVITY: _____

For each waste stream generated, determine:

- Point of origin _____
- Subsequent handling/treatment/disposal _____
- Physical and chemical characteristics _____
- Quantity _____
- Rate of generation (i.e., lbs/unit of product) _____
- Variations in generation rate _____
- Potential for contamination or upset _____
- Cost to manage or dispose _____

List all toxic substances used in this process:

List reduction options for this process:

Which option is economically most feasible? Explain:

Which option is technically most feasible? Explain:

How much reduction is realistic? Over what period of time? (This is your waste reduction goal for this waste stream.)

List positive and negative impacts on the environment or on employee health and safety.

Toxic substances affected:

Other waste streams affected:

Products affected:

Option proposed on (date):

Option approved for implementation? YES NO **Date:** _____

Reason for acceptance or rejection:

Step 5. Track Your Costs

Once you've identified your wastes, you need to quantify and determine their costs as accurately as possible. Reports which you've submitted to regulatory authorities can help you estimate waste quantity and disposal costs. Develop further details by having team members measure individual waste streams over a period of time to establish a verified generation rate.

An accounting system should be in place to routinely track the quantities, disposal method and disposal costs for every waste stream produced. This information is very useful in identifying waste reduction opportunities, prioritizing efforts and tracking the overall success of the program. The costs of waste management include more than just the fee paid to the removal contractor. True costs of waste management include:

- Costs (actual) of waste stream materials, based on the purchase price of those materials. The value of the waste material is the initial cost less any scrap credits.
- Costs (actual) of managing wastes, including costs for personnel, recordkeeping, monitoring, training, inspections, manifesting and labeling. Also include costs for transportation, laboratory fees, penalties and fines, liability insurance, pollution control equipment, treatment and disposal and others.
- Costs (estimated) of waste reduction, including initial costs, amortization, depreciation, tax rebates and payback potential.
- Costs (estimated) of liability, especially long-term.

These costs should be charged to the product or the process that generates the waste. Department managers can be motivated to reduce waste when they realize the costs.



DO IT NOW! *Fill in the costs of your wastes in line 2 of the Waste Reduction Options Worksheet on page 25.*

Step 6. Evaluate Your Options

When the causes of waste are understood, the assessment process enters the creative phase. Your objective at this step is to generate a comprehensive set of waste reduction options. Consider every waste stream as a reduction opportunity until proven otherwise. Most of the time, an opportunity exists if a waste stream exists.

Following the collection of data and site inspections, the members of the team will have begun to identify possible ways to reduce waste in the assessed areas. Identifying potential options relies both on the expertise and creativity of the team members. Much of the information you need can come from their education and on-the-job experience.

Your waste reduction team should list all the possible opportunities to reduce waste within the facility. The list may include several options for each waste stream or process. At this stage in the assessment process, assessors should not consider in detail the technical or economic usefulness of any particular option. Develop the list based on a broad range of general opportunities identified by asking questions about each phase of your process:

- **Product design:** Does product design require use of hazardous materials in later stages of production? Could negotiation with the customer produce desirable changes in product formulation or design?
- **Raw material substitutions:** Would different materials result in a less hazardous or less toxic product? Do raw materials require use of hazardous materials in later stages of production?
- **Materials handling:** Does the form in which raw materials are received place unnecessary constraints on design or processing? Are materials delivered in just-enough, just-in-time fashion?
- **Changes in processes, equipment, or operations:** Would upgrading machinery result in less use or release of hazardous materials? Do production runs and schedules optimize the use of material?
- **Housekeeping procedures:** What housekeeping procedures cause problems later on?
- **Maintenance procedures:** Is maintenance adequate, regularly scheduled and implemented?
- **Training procedures:** Are operators trained in (and using) the most efficient production processes?
- **In-process recycling/reuse:** Are there ways to recycle materials within the production process for later reuse?
- **Reclaiming, recycling and reusing waste materials:** Are there ways to recycle scrap or other waste materials while minimizing the risk of worker exposure or release to the environment?

Don't forget to consult waste reduction information resources, including case studies highlighting what other companies have done to reduce waste. A list of resources, including Internet sites, is available from CIS.

Rank Your Options Using the Waste Management Hierarchy

1. Source reduction options:

- Improved operating practices.
- Employee training and awareness programs.
- Scheduling to eliminate frequent equipment cleaning.
- Process improvements.
- Input changes.
- Changes in the composition or design of a product.
- Separation of wastes.

2. Reuse / recycle options:

- Return waste to the originating process as a substitute for a raw material.
- Use waste as a raw material in another process.
- Reclaim waste for sale or use as a fuel.
- Buy, sell or barter wastes using waste exchange services.

3. Treatment options:

- Process waste to reduce disposal cost and to minimize environmental damage. Consider treatment options only after identifying acceptable waste reduction techniques.

Now you're ready to discuss which of the options are feasible. You need a detailed analysis from both the technical and economic viewpoints to choose the best waste reduction options.

Technical Evaluation

Determine whether a proposed option will work and whether there are any facility constraints or product requirements that make it technically unwise to install and operate. The completed technical evaluation is reviewed by all affected groups. If a project appears impractical, or is found unacceptable through unsatisfactory answers to any of the questions below, drop it until more promising options have been investigated.

Economic Evaluation

If capital expenditures are necessary, generate an estimate of the total cost of implementation. Companies with sizable engineering departments probably have preset methods for estimating capital projects. If you are a smaller company, be sure that the capital cost estimate includes all costs incurred in getting the new process or equipment to the site, installed and ready to operate. There also may be changes in operating costs to consider, such as energy and material handling costs, as well as maintenance and training costs for the new process or equipment.

Use the capital and operating cost estimates as the basis for a final recommendation by whatever method the company normally uses for profitability analysis (i.e., return on investment, payback period and net present value).

Writing a Waste Reduction Plan

During the screening procedure, assessors should consider:

- Does each option have a good track record? If not, is there convincing evidence that the option will work as required?
- What is the main benefit to be gained by implementing this option (e.g., economics, compliance, liability, workplace safety, etc.)?
- What other benefits will accrue?
- Does the option have a good chance of success?
- Can it be implemented without disrupting production?
- Does the necessary technology exist to develop it?
- How much does it cost? Is it cost effective?

Sample Matrix For Evaluating Waste Reduction Options

	Waste #1	Waste #2
Options available	<ul style="list-style-type: none"> • Change to nonhazardous raw material • Reclaim waste on site • Reclaim waste off site 	<ul style="list-style-type: none"> • Improve inventory control • Rotate stock • Return to vendor • Change to water-based
Economically feasible options	<ul style="list-style-type: none"> • Change to nonhazardous raw material 	<ul style="list-style-type: none"> • Improve inventory control • Rotate stock • Return to vendor
Technically feasible options	<ul style="list-style-type: none"> • Change to nonhazardous raw material • Reclaim waste on site • Reclaim waste off site 	<ul style="list-style-type: none"> • Improve inventory control • Rotate stock • Change to water-based
Options chosen	<ul style="list-style-type: none"> • Change to nonhazardous raw material 	<ul style="list-style-type: none"> • Improve inventory control • Rotate stock

Once you have determined the most feasible options, you may go ahead and put them into use. Bear in mind, however, that as technology and economic conditions change, so may the feasibility and effectiveness of your waste reduction program. Therefore, you should keep all options open and review them on a regular basis.



DO IT NOW! *Complete all items in the form below, then rank your waste reduction options.*

Waste Reduction Options Worksheet

	Waste #1	Waste #2
1. Current amount generated		
2. Costs		
3. Standard unit of production		
4. Reduction options		
5. Technical feasibility		
6. Economic feasibility		
7. Selected option(s)		
8. Reduction goal		
9. Target date		
10. Target standard unit of production		

Step 7. Implement the Plan

Once you've identified reduction techniques for each waste stream, it's time to develop an implementation plan. This plan includes:

- Conceptual design.
- Implementation requirements.
- Management requirements.
- Implementation schedule.
- Equipment needs.
- Cost estimates.

Plans that require only operational, procedural and/or materials changes can be put into action at once. Plans that require changes in equipment may take a little longer to implement, but they are essentially no different from any other capital improvement project whose phases include planning, design, procurement and installation.

Your goals and implementation schedule should include:

- Selecting alternatives for implementation (prioritize and list conditions for adoption).
- Identifying measurable performance goals for each hazardous waste stream.
- Establishing outcome objectives and ranges of acceptability.
- Identifying steps or phases and timing for implementation.
- Identifying tasks and personnel assignments.
- Training and involving all personnel in the business.
- Setting target dates for completion of goals.

Overcoming Barriers to Implementation

Certain attitudes can get in the way of implementing waste reduction options. This can be frustrating to the whole assessment team.

Common barriers include:

- Other priorities. ("We've earmarked these funds for something more important.")
- Skepticism. ("That won't work." Or, "We've tried that before.")
- The status quo. ("If it ain't broke, don't fix it.")

This waste reduction program is intended to overcome such attitudinal barriers early by:

- Obtaining high-level commitment early in the process.
- Representing all groups in the plant on the task force.

- Carefully analyzing and evaluating all options.

As a key advocate for a waste reduction plan at your facility, you should be prepared to offer a convincing rationale for its implementation. You do not have to include acts of God or other unforeseeable events. But you should consider, and be able to show evidence in support of:

- The economic feasibility and benefits of waste reduction.
- The status of current and pending technology.
- The success of earlier waste reduction efforts, both at your facility and elsewhere.

The most important consideration at this point is to stay on task. You and your colleagues on the waste reduction task force should not consider your jobs finished until the recommended measures have been implemented, or at least until the project is funded and scheduled.

Step 8. Measure Results

Implementing a waste reduction plan is one thing; showing that it has achieved its objectives is another. The following are some useful measurements:

- Ratio of waste generated to production unit or rate, before and after implementation.
- Savings in raw materials and waste disposal cost.
- Quantities of waste generated before and after implementation.
- Ratio of raw materials consumed to production rate, before and after implementation (an indirect measure of waste reduction).

In general, waste generation depends directly on the production rate. Measuring waste reduction by comparing quantity of waste or input materials to production rate is generally more useful if applied to a single production unit rather than to an entire plant. This is especially true of plants where dissimilar processes and operations are included in one facility. Consider wastes generated on a periodic basis, such as waste from maintenance or construction, separately from production wastes, unless the evaluation includes at least one repetition of the periodic cycle.

How Does One Measure Effectiveness?

One measure of effectiveness for a waste reduction project is the project's impact on the organization's cash flow. The project should pay for itself through reduced waste management costs and reduced raw materials costs. However, measuring the actual reduction of waste is also important. The easiest way to measure waste reduction is by recording the quantities of waste generated before and after a waste reduction project was implemented. The difference, divided by the original rate of waste generation, represents the percentage of waste reduced. However, this simple measurement ignores other factors also affecting the quantity of waste generated.

The ratio of waste generation rate to production rate is a convenient way to measure waste reduction. However, this ratio is not accurate for large quantities of waste that is generated infrequently. To assure accuracy, distinguish between production-related wastes, maintenance-related wastes and cleanup wastes.

Also, a few waste streams may be inversely proportional to production rate. For example, waste from old materials will increase if the production rate decreases. This is because the old materials in inventory are more likely to expire when its production use decreases.

In measuring waste reduction, businesses should measure the total quantity of an individual waste streams as well as the individual waste components. Often, good housekeeping and concentrating a dilute aqueous waste cause much of the reduction. Although concentration, as such, does not fall within the definition of waste reduction, practical benefits result from concentrating water waste streams, including decreased disposal costs. Concentrating a waste stream makes it easier to recycle and may reduce the load on a facility's wastewater treatment system.

Obtaining good quality data for waste stream quantities, flows and composition can be costly and time consuming. For this reason, it is sometimes practical to express waste reduction indirectly,

in terms of the ratio of input materials consumption to production rate. These data are easier to obtain although the measure is not direct.

Measuring waste reduction with a ratio of waste quantity to material throughput or product output is generally more meaningful for specific operations rather than for an entire facility. Therefore, preserving the focus of the project when measuring and reporting progress is important. For those operations without chemical reactions, measuring progress with the ratio of input material quantity to material throughput or production rate may be helpful.



DO IT NOW! *Establish your measurement tools. Use charts, graphs and other visuals to promote the waste reduction successes. These data will also be used to calculate your responses to questions 12–15 on the Annual Report of Hazardous Waste Activity.*

Step 9. Make a Long-term Commitment

To insure continued reductions, a business must monitor and evaluate techniques once they are in place. Your plan should address updating procedures as well as integrating the program into the management structure. In addition, the program should allow for production changes and development of new reduction techniques.

Waste planning (and assessing) offers ways to improve management of a waste reduction program and introduce new technologies and practices.

Much of the planning for a waste reduction program requires:

- Increased awareness and attention to hazardous chemicals.
- Increased awareness and training to change old work patterns.
- Knowledge of options for change.
- Willingness to experiment and to change.
- Management's willingness to provide resources for change.
- Willingness to follow through, evaluate and learn from changes.

Management's commitment to change makes the difference between simply preparing a plan and preparing and **implementing** a plan. Implementation is the key. The law requires annual reports summarizing progress toward both the general and quantitative objectives in your plan.

Since changes seldom occur as planned and facilities change over time, you need to monitor your waste reduction plan to ensure its usefulness. This means long-term management support and, in many cases, a champion within the organization whose job includes staying abreast of the waste reduction program and making needed updates.



DO IT NOW! Congratulations! Your draft waste reduction plan is complete. To design a final version, combine the information from the preceding exercises (pages 10-12, 15, 20 and 25). Take your plan to management for approvals, begin the top priority projects, and keep track of the waste generation and waste reductions for your annual update and annual report! A sample plan is included in Appendix B.

Updating Your Waste Reduction Plan

The law requires all generators to review their waste reduction plan annually, and to complete a waste reduction progress report. These will help you to:

- Analyze and quantify the progress made toward your goals.
- Amend your plan as needed, and explain any modifications made to the plan.

The update must be completed by March 1 of each year, because this information is necessary to complete the waste reduction questions in the Annual Report. Like your initial report, the annual progress report is also considered confidential.

Five Steps to Updating Your Waste Reduction Plan

Updating your plan is a bit like going through the original process, only in reverse:

Step One:

Review the employee involvement process. Is there a new waste reduction process that needs explaining? Are there new employees who need training? Are employees still actively involved in offering suggestions for waste reduction?

Step Two:

Conduct another waste assessment. Are there new hazardous wastes? Have any wastes been eliminated? Have the costs changed? Update the forms on pages 17, 20 and 25.

Step Three

Reevaluate the options. Are there new options previously not considered? Are any of the options previously rejected now feasible?

Step Four:

Reexamine the scope of your plan. Have products, processes or waste streams changed significantly? Should your plan be broadened? Or should it be more focused?

Step Five:

Renew the management commitment. While it is not required that managers sign the policy statement again (unless there has been a change in leadership), their signature on the updated plan demonstrates their continued support.

Your Waste Reduction Plan and the Annual Report

In your annual update, you will calculate the amount of hazardous waste generated in the previous calendar year. This amount will be reported in line 11 of the Annual Report of Hazardous Waste Activity that you file with the state of Tennessee. In line 12 of that report, you are asked to report the waste reduction ratio, the goal year ratio, and the goal year. These are calculated as follows:

Actual Ratio:

$$\frac{\text{total kilograms of this hazardous waste generated in previous year}}{\text{number of standard units of production in the same year}}$$

Goal Year Ratio:

$$\frac{\text{estimated total kilograms of hazardous waste generated in goal year}}{\text{estimated number of standard units of production}}$$

Goal Year:

the year you anticipate achieving this reduction

Examples

- A. Last year your company generated 2,393 kg of hazardous waste last year. Since the waste came from a cleanup process, you selected as your standard unit of production the number of cleanups. Last year, you conducted 23 cleanups. For a goal year of 2001, you expect to generate 2,000 kg of waste in the course of 30 cleanups.

Actual Ratio: $\frac{2,393 \text{ kg}}{23 \text{ cleanups}} = 104.4$

Goal Year Ratio: $\frac{2,000 \text{ kg}}{30 \text{ cleanups}} = 66.7$

Goal Year: 2001

- B. Your company generates a hazardous waste from a painting process. Last year, you generated 5,000 kg of waste while painting 10,000 parts. Your goal in 2005 is to generate 5,500 kg of waste while painting 17,000 parts. Your standard unit of production is the number of parts painted.

Actual Ratio: $\frac{5,000 \text{ kg}}{10,000 \text{ parts painted}} = 0.5$

Goal Year Ratio: $\frac{5,500 \text{ kg}}{17,000 \text{ parts painted}} = 0.3$

Goal Year: 2005

Conclusion

Congratulations! You're well on your way to a waste reduction plan that can save your facility significant money and resources while complying with regulations and safeguarding the environment. By following the steps outlined in this manual, you have also been following in the steps of countless other Tennessee businesses that have seen the benefits of waste reduction planning.

The Tennessee Hazardous Waste Reduction Act of 1990 may yet prove to be one of the most beneficial laws ever written!



Appendix A: The Tennessee Hazardous Waste Reduction Act of 1990

This is an unofficial copy of the Tennessee Hazardous Waste Reduction Act of 1990 (TCA 68-212-301 et. seq.). This copy is provided for educational purposes only. For an official copy, contact TDEC or your legal counsel. The text of the law is available online at www.michie.com/resources/.

AN ACT relative to hazardous waste reduction plans, and to amend Tennessee Code Annotated, Title 68, Chapter 212.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF TENNESSEE;

SECTION 1. Tennessee Code Annotated, Title 68, Chapter 212, is amended by adding Sections 2 through 12, inclusive, and Section 15 of this act as a new part to be appropriately designated as sections 301-312.

SECTION 68-212-301. This act may be cited as the Tennessee Hazardous Waste Reduction Act of 1990.

SECTION 68-212-302. (a) The General Assembly declares it to be the policy of the state that, wherever economically and technically feasible, the generation of hazardous waste is to be prevented or reduced as expeditiously as possible. Hazardous waste that is nevertheless generated should be stored, treated and disposed of so as to protect human health and the environment.

(b) It is the intent of the General Assembly that the Capacity Assurance Plan (CAP) required by the Superfund Amendments and Reauthorization Act of 1986 (SARA) (P.L. 99-499, 100 Stat. 1613, as amended) should reflect the state's primary commitment to waste prevention and reduction through education, planning and technical assistance.

(c) The General Assembly further finds that the timely development of a comprehensive waste reduction plan by each large and small hazardous waste generator operating in the state is essential in order to identify opportunities for reducing waste generation which may be implemented by that generator.

(d) The General Assembly finds that the state should aid generators of hazardous waste to meet the requirements of this act, by providing a program of planning and technical assistance.

(e) It is the purpose of this act to prevent and reduce the generation of hazardous waste in the state. The state's goal is to reduce the aggregate level of hazardous waste, adjusted for economic growth, that is generated within Tennessee by twenty-five percent (25%) before June 30, 1995; provided, however, that such waste shall not include wastewater streams containing hazardous wastes that are

collected and treated in on-site wastewater treatment systems, the discharge of which is the subject of a NPDES permit.

SECTION 68-212-303. As used in this act:

- (1) "Board" means the solid waste disposal control board as established by Tennessee Code Annotated, Section 68-31-111.
- (2) "Commissioner" means the Commissioner of Health and Environment or his authorized representative. *(N.B., the commissioner of Health and Environment is now designated the Commissioner of Environment and Conservation.)*
- (3) "Department" means the Department of Health and Environment. *(N.B., the Department of Health and Environment is now the Department of Environment and Conservation.)*
- (4) "Large quantity generator" means a generator who generates 2.2 pounds of acute hazardous waste, or two thousand two hundred (2,200) pounds or more of hazardous waste in any one (1) month.
- (5) "Small quantity generator" means any generator who generates between two hundred twenty (220) and two thousand two hundred (2,200) pounds of hazardous waste in any one (1) month.
- (6) "Source reduction" or "waste reduction" means the reduction or elimination of waste at the source, usually within a process, including process modifications, feedstock substitutions, improvements in feedstock purity, housekeeping and management practices, increases in the efficiency of machinery and on-site, closed-loop recycling, or any action that reduces the amount and toxicity of the waste exiting the production process.
- (7) "Waste," or "hazardous waste," or "acute hazardous waste," means any hazardous waste as defined in Tennessee Code Annotated, Title 68, Chapter 212, Part 1, and the regulations promulgated pursuant thereto, and for which the generator is required to notify the department pursuant thereto, and for which the generator is required to notify the department pursuant to such regulations.

However, for the purpose of this act only, these terms shall not include such wastes which result from the cleanup of contaminated sites or spills of hazardous material.

- (8) All other terms used in this part shall be defined as such terms are defined in Tennessee Code Annotated, Title 68, Chapter 212, Part 1 or in regulations promulgated pursuant to that part.

SECTION 68-212-304. (a) All large quantity generators shall complete a hazardous waste reduction plan on or before January 1, 1992, and all small quantity generators shall complete a hazardous waste reduction plan on or before January 1, 1994. Any generator first generating a hazardous waste stream after December 31, 1989, or first becoming a hazardous waste generator after December 31, 1989, shall determine whether he is a large quantity generator or a small quantity generator based on the amounts generated during the initial twenty-four (24) months of generation of the hazardous waste stream. Within the period ending twelve (12) months after this determination is made or by March 1 following the end of the twelve (12) month period, whichever is later, a hazardous waste reduction plan shall be completed by large quantity generators (or until three-year period exceeds January 1, 1994, for small quantity generators). Upon completion of a plan, the generator shall maintain a

Writing a Waste Reduction Plan

current copy of the plan at the generating facility. A generator shall determine whether he is a large quantity generator, based on the amount of waste generated during calendar year 1989.

(b) For the purposes of this section and Section 305, a generator shall permit the commissioner or the commissioner's designee to inspect the hazardous waste reduction plan. The generator shall permit any officer, employee or representative of the department at all reasonable times to have access to the plan. The generator shall furnish a copy of the plan upon request to the commissioner.

SECTION 62-21-305. (a) A hazardous waste reduction plan shall include at least the following:

(1) A dated and signed written policy articulating management support for the generator's hazardous waste reduction plan;

(2) The scope and objectives of the plan, including the evaluation of technologies, procedures and personnel training programs to insure that unnecessary waste is not generated and to encourage hazardous waste reduction. Specific goals shall be set for hazardous waste reduction, as described in subsections (b) (c) and (d) of this section;

(3) A description of technically and economically practical hazardous waste reduction options to be implemented and a planned schedule for implementation. These options shall be based on an internal analysis of hazardous waste streams conducted to review individual processes or facilities and other activities where waste may be generated and identify opportunities to reduce or eliminate waste generation. Such analyses shall evaluate data on the types, amount and hazardous constituents of waste generated, where and why that waste was generated within production process or other operations, and potential hazardous waste reduction and recycling techniques applicable to those wastes;

(4) A description of the hazardous waste accounting systems that identify waste management costs and factor in liability, compliance and oversight costs to the extent feasible;

(5) A description of the employee awareness and training programs designed to involve employees to the maximum extent feasible in hazardous waste reduction planning and implementation;

(6) A description of how the plan has been or will be incorporated into management practices and procedures so as to insure an ongoing effort; and

(7) Other information about generation of hazardous waste not requiring disclosure of proprietary information as the board may require by regulation.

(b) As part of each plan developed under this act, a generator shall establish specific performance goals for the source reduction of each hazardous waste stream.

(c) The specific performance goals established under subsection (b) of this section shall be quantitative goals, expressed in numeric terms. Whenever possible, the units of measurement should be in pounds (or tons) of waste generated per standard unit of production, as defined by the generator. If the establishment of numeric performance goals is not practical, the performance goals shall include a clearly stated list of actions designed to lead to the establishment of numeric goals as soon as practical.

(d) As part of each plan developed under this act, each generator shall explain the rationale for each performance goal. Acts of God or other unforeseeable events beyond the control of the generator do

not have to be considered in setting goals. The rationale for a particular performance goal shall address any impediments to hazardous waste reduction, including but not limited to the following:

- (1) The availability of technically practical hazardous waste reduction methods, including any anticipated changes in the future;
- (2) Previously implemented reductions of hazardous waste;
- (3) The economic practicability of available hazardous waste reduction may not be economically practical include but are not limited to:
 - (i) For valid reasons of prioritization, a particular company has chosen first to address other more serious hazardous waste reduction concerns;
 - (ii) Necessary steps to reduce hazardous waste are likely to have significant adverse impacts on product quality; or
 - (iii) Legal or contractual obligations interfere with the necessary step that would lead to hazardous waste reduction.

(e) The board, by rule, may provide for modifications and exclusions for small quantity generators related to the kind of information to be included in the plan. The board may provide for exception by rule for generators whose hazardous waste streams fluctuate widely due to contract work or manufacturing orders.

(f) A generator required to complete a hazardous waste reduction plan under subsection (a) of this section may include as a preface to its initial plan:

- (1) An explanation and documentation regarding hazardous waste reduction efforts completed or in progress before the first reporting date; and
- (2) An explanation and documentation regarding impediments to hazardous waste reduction specific to the individual facility.

SECTION 68-212-306. (a) All generators shall annually review their waste reduction plan and complete a hazardous waste reduction progress report which shall:

- (1) Analyze and quantify progress made, if any, in hazardous waste reduction, relative to each performance goal established under Section 305(b); and
- (2) Set forth amendments, if needed, to the hazardous waste reduction plan and explain the need for the amendments.

(b) Except for the information reported to the department under Section 308, the annual progress report shall be retained at the facility and shall not be considered a public record under Tennessee Code Annotated, Title 10, Chapter 7, Part 5. However, the generator shall permit any officer, employee or representative of the department at all reasonable times to have access to the annual progress report.

(c) Large quantity generators shall complete the first annual progress report required under subsection (a) of this section on or before March 1, 1993. Small quantity generators shall complete the first annual progress report required under subsection (a) of this section on or before March 1, 1995.

SECTION 68-212-307. (a) The department may review a plan or an annual progress report *to determine whether the plan or progress report reasonably contains the elements specified* under Sections 305 and 306 of this act. If a generator fails to complete a plan containing the elements required by Section 307, the department may notify the generator of the specific deficiencies. The department also may specify a reasonable time frame, of not less than ninety (90) days, within which the generator shall modify the plan or progress report correcting the specified deficiencies.

(b) If the Commissioner determines that a plan or progress report has not been modified to address the deficiencies identified, the commissioner may issue an order for correction to the responsible person, and this order shall be complied with within the time limit specified in the order. Such order shall be served by personal service or shall be sent by certified mail, return receipt requested. Investigations made in accordance with this section may be made on the initiative of the commissioner or board. Prior to issuance of any order or the execution of any other enforcement action, the commissioner may request the presence of the alleged violator of this part at a meeting to show cause why enforcement action ought not to be taken by the department.

(c) Any order issued pursuant to subsection (b) of this section shall be subject to review in the same manner as for orders under Tennessee Code Annotated, Section 68-212-113.

SECTION 68-212-308. (a) Based on the annual progress report prepared pursuant to Section 306 of this act, each generator shall submit summary information on waste reduction activities to the department, as an element of the annual generator report submitted to the department.

(b) The summary shall include:

(1) For each hazardous waste stream, one of the following, as appropriate;

(A) A statement of specific performance goals, and a report on the progress made in achieving these goals, and a report on the progress made in achieving these goals. The results should be reported numeric terms, as set forth in Section 305(c) or goals; and

(B) A report on the actions taken toward establishing numeric goals.

(2) A narrative explaining the reported data; and

(3) A description of any impediments to reducing the generation of hazardous waste.

(c) The board, by rule, shall develop uniform reporting requirements for the data required under this section.

SECTION 68-212-309. Any generator or person who:

(1) fails to file any reports, records or documents required pursuant to this act;

(2) who fails, neglects or refuses to comply with any provision of this act or any order issued pursuant to this act; or

(3) who knowingly gives or causes to be given any false information in any reports, records, or documents required pursuant to this act; shall be subject to a civil penalty of up to ten thousand dollars (\$10,000). Any such penalty shall be assessed in the same manner as in Tennessee Code Annotated, 68-212-114. Each day such violation continues shall constitute a separate offense.

SECTION 68-212-310. Subject to available funding, the department may contract to make technical assistance available to assist generators and the department in carrying out the provisions of this act. The assistance shall emphasize strategies to encourage hazardous waste reduction.

SECTION 68-212-311. A plan or annual progress report developed pursuant to this act and maintained at the generating facility shall not be considered a public record under Tennessee Code Annotated, Title 10, Chapter 7, Part 5. The board shall establish procedures to insure that information supplied to the department, as provided by this part, and defined as proprietary by regulation, is not revealed to any person without the consent of the person supplying such information. However, the summary information on waste reduction activities submitted to the department may be utilized by the commissioner, the board, the department, the United States Environmental Protection Agency, or any authorized representative of the commissioner or the board in connection with the responsibilities of the department or board pursuant to this part or as necessary to comply with federal law.

SECTION 13. Tennessee Code Annotated, Section 68-212-205(d)(1) is amended by adding the following as a new item to be appropriately designated:

() To review waste reduction plans prepared pursuant to this chapter;

SECTION 14. Tennessee Code Annotated, Section 68-212-205(b), is amended by deleting the following language:

Provided, however, that such fund shall not be used for hiring personnel for continuing programs of the Department of Health and Environment pursuant to part 1 of this chapter or for any long term research activities.

SECTION 68-212-312. In addition to all other enumerated powers in Tennessee Code Annotated, Title 68, Chapters 31 and 212, the board is authorized to promulgate rules and regulations to effectuate the purpose of this act, and to hear appeals from orders or assessments issued by the commissioner pursuant to this part. All such rules and regulations shall be promulgated in accordance with the provisions of Tennessee Code Annotated, Title, Chapter 5.

SECTION 16. This act shall take effect on July 1, 1990, the public welfare requiring it.

PASSED MARCH 21, 1990

Appendix B: Sample Waste Reduction Plan

**Company ABC
Anytown, USA**

WASTE REDUCTION PLAN

Preface

Company ABC is committed to protecting the environment. Following the enactment of the Tennessee Hazardous Waste Reduction Act, we at Company ABC implemented the following processes and procedures to reduce waste.

Parts Cleaning

In 1993, Company ABC installed a Hotsy aqueous washer to replace a large solvent dip tank. Until it was removed a few years ago, the dip tank was used to clean parts that were too large for the parts cleaning tanks. The new Hotsy washer uses a nonhazardous detergent and hot water. No hazardous waste is anticipated from the new process.

The Hotsy cleans parts effectively and timely. Most parts can be cleaned within a 10-minute cycle. We have successfully cleaned engine blocks, engine parts, transmissions and many other parts.

The Hotsy runs on a timer so that the washer is turned off nights and weekends and automatically starts heating up prior to opening.

The washer also has an oil skimmer to remove oil from the water. We expect the water to last for approximately six months, at which time we will determine if it can be discharged to the sanitary sewer. The washer is topped off with fresh water and soap as needed.

Painting

In 1992, Company ABC switched from purchasing premixed paints to a paint mixing process. Due to the many color and batch variations among auto body paints, we bought a large amount of paint. Paint was often wasted when it did small jobs that required little paint.

ABC now has a system that mixes any color or batch of paint to match the automobile paint. We mix paint in various amounts, thereby reducing excess waste.

In 1992, we also installed a gun cleaner that recirculates the solvent. Prior to installing this cleaner, our painters used a bucket of solvent and manually cleaned guns.

Company ABC
Waste Reduction Policy Statement

Company ABC is committed to playing a leadership role in protecting the environment. Whenever feasible, we will eliminate, reduce, or recycle our waste in full compliance with all Federal and State Regulations. Our employees are urged to participate in all types of waste reduction.

President, Company ABC

Date

1999 update:

President, Company ABC

Date

2000 update:

President, Company ABC

Date

2001 update:

President, Company ABC

Date

2002 update:

President, Company ABC

Date

Company ABC

Waste Reduction Objectives

To comply with the Tennessee Waste Reduction Act and improve the environment, all employees of Company ABC will be involved in waste reduction. RCRA hazardous waste will be our first priority for waste reduction.

Our goal is to reduce hazardous waste streams to the technically feasible and economically practicable minimum by the timetable noted in the contents of the plan. We will achieve these reductions through waste reduction assessments, procedure improvements, equipment changes, material substitution, employee training and other reduction methods.

Company ABC

Waste Reduction Administration

The day shift foreman will act as the waste reduction coordinator for Company ABC. The waste reduction coordinator will administer the plan, prepare the annual progress report and update the plan needed.

Waste reduction options will be evaluated by all foremen, the service director, the plant manager and applicable employees.

Waste reduction can be achieved only with the cooperation of employees who work in the areas and processes where waste is generated. Therefore, all employees will be made aware of the need for waste reduction. Training will be incorporated into the Hazard Communication training. Employees will also be trained on operator-dependent waste reduction techniques.

Waste costs are computed from the following costs:

- Cost of raw material lost to waste (if applicable).
- Labor.
- Waste transportation/treatment/disposal.
- Laboratory fees (if applicable).

Company ABC Waste Reduction Plan

Waste Stream #1: Waste Paint-related Material

Company ABC has an automated, enclosed paint booth for autobody repairs. The spray guns are manual High Volume Low Pressure (HVLP) guns. Waste is generated from leftover paint and gun cleaning. Waste is collected in a 55-gallon drum and shipped offsite for fuel blending.

Waste Stream #1: Waste Generation

Year	Waste generated (lbs)	Bodyshop repair orders	Waste (lbs) per repair order	Cost of waste
1989	1,505	1,342	1.12	N/A
1990	1,441	840	1.72	N/A
1991	1,161	1,000	1.16	N/A
1992	1,764	1,432	1.23	\$5,200
1993	1,199	952	1.26	\$3,850
1994	1,200	1,011	1.19	\$4,040
1995	1,150	1,050	1.10	\$4,200
1996	1,145	1,200	0.95	\$4,275
1997	1,100	1,225	0.90	\$4,200
1998	1,050	1,201	0.87	\$4,200
1999				

Cost of waste includes transportation, disposal and raw material loss:

Disposal/transportation	\$500/year
Average paint cost	\$35/gallon
Average thinner cost	\$20/gallon

In 1992, Company ABC implemented two waste reduction measures for waste contributing to the paint waste stream. A paint mixing station was installed which allowed us to mix our own paint colors. With the new paint system, we are able to mix the quantity of paint needed for the job. This reduces the excess paint, thereby reducing the waste. Weighing accuracy becomes critical. If operators do have leftover paint, they save it in small paint containers for the next job of the same color.

We also installed a recirculating gun-cleaning tank to replace manual dipping and cleaning. The gun-cleaning tank holds 5 gallons of solvent. Guns and paint pots are rinsed with a small amount of solvent and then placed in the tank, which cleans them in about 45 seconds. The solvent is changed out monthly, and the tank is refilled using reclaimed solvent purchased from a vendor.

Waste Stream #1: Barriers to Reduction

- **Substitute paint.**

We are currently unable to substitute a nonhazardous paint due to car manufacturers paint types. Since we have to match GM and other car manufacturers paint, we must use the same type. GM is currently evaluating substitute paint. If GM approves water-based paints, we will adopt this waste reduction strategy. Our waste generation would decrease, however the phase out time of the solvent based paint would be significant.

- **Reuse gun cleaning solvent to thin paint.**

This option is not feasible due to the various paint colors and types and the exact measurements of mixing. Contaminants in the thinner would ruin the paint.

- **Solvent distilling on site.**

Solvent distillation is economically unfeasible for our low generation rate.

Waste Stream #1: Waste Reduction Options

The following options are being assessed as possible waste reduction measures:

- Substitute paint. This would follow auto manufacturers lead. If implemented, we would be required to keep two systems for many years for older cars.
- Scrape paint cup with a spatula prior to placing in gun cleaner.
- Train operators to reduce overspray:
 - ✓ Ensure spray gun nozzles are clean and not damaged.
 - ✓ Maintain a gun distance of 6-8 inches from the workpiece.
 - ✓ Trigger gun at the end and the beginning of each stroke.
 - ✓ Ensure proper pressure is on gun stroke.
- Settle solids out of paint gun cleaning tank, remove and reuse the solvent.

Except for the substitute paint, the above waste reduction measures can be implemented without a significant cost. The waste reduction would result in decreased disposal costs. Operators will be trained on practices during 1993 and improvements will be ongoing.

Installing a water-based system will be very expensive but cost will not be a prohibiting factor. Costs at this time are unknown.

Waste Stream #1: Goals

Goal year	Waste (lbs) per repair order
1993	0.55
1994	0.50
1995	0.45
1996	1.00
1997	0.90
1998	0.85
1999	0.85
2000	0.75
2001	0.75
2002	0.70

Annual Updates

- 1993 Conducted employee training. Waste costs increasing due to raw material price increase and increasing disposal costs. Substitute paint still not possible. Other barriers still remain.
- 1994 High employee turnover and inability to substitute paint is keeping waste amounts higher than anticipated. Costs contained by diligence of John Smith, Foreman and employee involvement.
- 1995 No changes.
- 1996 Set new, more realistic goal.
- 1997 Purchased new spray guns which are easier to clean, requiring less solvent for cleanups.
- 1998 No changes.
- 1999 Lowered goal for 2000-2001 to 0.75; lowered goal for 2002 to 0.70.

Waste Stream #2: Mineral Spirits Parts Cleaning Solvent

Company ABC generates a mineral spirits parts cleaning solvent waste when its parts cleaners are changed out. We currently have seven parts cleaning tanks which are changed out as needed on a contract. The contract price includes solvent replacement, transportation and permitted recycling.

In 1992, we installed a "Hotsy" aqueous parts cleaner to replace one of the solvent dip tanks. This washer cleans large parts, such as engine blocks and transmissions, using a detergent and hot water. We anticipate changing the wash water every six months to a year. We believe this wastewater to be nonhazardous.

The cost to purchase the larger Hotsy was \$6,000.

Waste Stream #2: Waste Generation

Year	Waste generated (lbs)	Mechanical repair orders	Waste (lbs) per repair order	Cost of waste
1989	3,868	11,643	0.33	N/A
1990	2,398	9,469	0.32	N/A
1991	3,555	10,765	0.30	N/A
1992	4,173	11,095	0.30	\$1,922
1993	4,277	11,178	0.38	\$2,406
1994	1,200	11,451	0.10	\$800
1995	550	11,324	0.05	\$325
1996	0	11,501	0.00	\$0
1997	0	11,642	0.00	\$0

Waste Stream #2: Waste Reduction Options

ABC Company uses the solvent until its cleaning capacity is exhausted. All tanks are used regularly. At this time we will not consider on-site distillation because our intention is to replace hazardous solvent with aqueous cleaners.

- **Replace all solvent parts washers with aqueous washers.**
We expect to need two, possibly three more Hotsies to replace our seven solvent parts cleaners. These will be smaller than the first unit, costing approximately \$3,000 each. Estimated payback for two washers is 3.2 years.
- **Inform operators to drain parts into tank rather than blow off with compressed air.**
- **Turn off parts washers when not in use.**
Currently, washers are turned off only during nonbusiness hours.

The Hotsy parts washers will be purchased yearly starting in 1994. Other measures will be communicated in 1993. If we cannot purchase aqueous cleaners, we will consider solvent distillation.

Waste Stream #2: Costs

Estimated Cost:

Investment of still	\$5000
Annual maintenance of waste streams:	
Replenishing solvent	\$200
Utilities & labor	unknown
Still bottom disposal	\$500

Estimated Savings:

Cost of waste paint/thinner and parts cleaner	\$1,900
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Estimated Payback: 3 years

The still may also be used to distill gun-cleaning solvent. The estimated payback period would not change significantly due to the low volume.

Waste Stream #2: Goals

Year	Waste (lbs) per repair order
1993	0.27
1994	0.15
1995	0.05
1996	0.00
1997	0.00
1998	0.00
1999	0.00
2000	0.00

Annual updates

- 1993 Presented request for Hotsy washer to ABC Company's board of directors. Reluctance on the part of the Quality Control and Production departments caused purchase to be delayed. Conducted further study.
- 1994 Received approval to purchase one large Hotsy washer for \$6,000.
- 1995 Purchased second Hotsy washer.
- 1996 Closed waste stream with TDEC.
- 1997 System working well. Employee training being continued on proper operation of washers. Wash water tested regularly to confirm it is not a hazardous waste.

Appendix C: Waste Reduction Plan Checklist

Your plan may have a preface, including:

- Waste reduction activities completed or implemented to date.
- Impediments to waste reduction specific to the facility (e.g., legal or contractual obligations).

Your plan must include:

- A written policy, signed and dated by management.
- A statement of scope and objectives addressing procedures, evaluation of technologies and training to be used to eliminate unnecessary waste and encourage hazardous waste reduction and minimization.
- An assessment and characterization of waste streams, including types, amounts, costs and reasons for the waste.
- An evaluation (including technical feasibility, economic feasibility and prioritization) of all the reduction options that apply to each waste stream.
- Specific quantitative goals for hazardous waste reduction/minimization in numeric terms (e.g., kgs, lbs, or tons per production unit).
- An explanation or rationale for each performance goal and any specific impediments to obtaining that goal.
- A description of your accounting system for tracking and managing waste management costs (e.g., raw material loss, labor, compliance and liability costs).
- A description of employee waste reduction awareness and training programs.
- A description of methods to make the plan part of your company's standard practices.

Appendix D: Waste Reduction Resources

University of Tennessee Center for Industrial Services

T.C. Parsons, Director

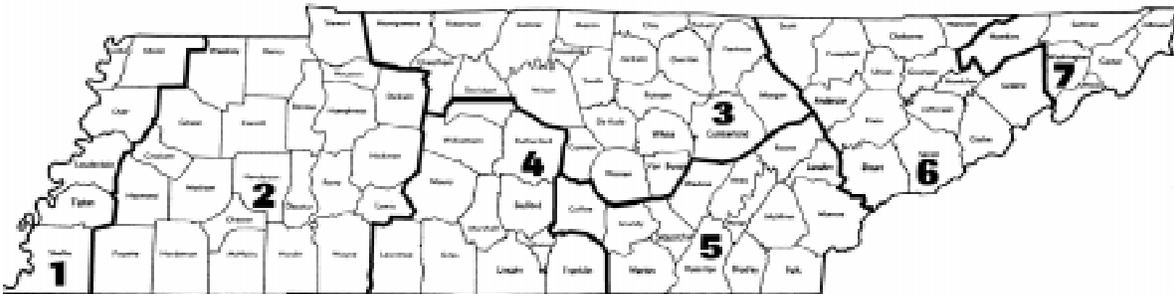
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Bibliography

Georgia Tech Research Institute. *Georgia Pollution Prevention Guide*. Atlanta, GA: Georgia Tech Research Institute, 1990. 404-894-3806.

Minnesota Office of Waste Management. *Minnesota Guide to Pollution Prevention*. Saint Paul, MN: Minnesota Office of Waste Management, 1991. 612-649-5750.

North Carolina Pollution Prevention Pays Program. *Developing and Implementing a Waste Reduction Program*. Selected References on Developing a Waste Reduction Program. Raleigh, NC: Department of Natural Resources and Community Development, 1988. 800-476-8686.

Oregon Department of Environmental Quality. *Benefiting from Toxic Substance and Hazardous Waste Reduction*. Portland, OR: Oregon Department of Environmental Quality, 1990. 503-229-5913

United States Environmental Protection Agency. *The EPA Manual for Waste Minimization Opportunity Assessments*. EPA/600/2-88-025. Cincinnati, OH: US EPA ORD Pollution Prevention Research Branch, 1988. 513-569-7215.

United States Environmental Protection Agency. *Waste Minimization: Environmental Quality with Economic Benefits*. EPA/530-SW-87-026. Washington, DC: US EPA Office of Solid Waste and Emergency Response, 1987. 800-369-5888.

University of Tennessee Center for Industrial Services. *Waste Reduction Assessment and Technology Transfer Training Manual, Second Edition*. Nashville, TN: UT-CIS, 1989. 615-532-8657.

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